

# Strategic Management of Complex Large-Scale Space Technology

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## Why Strategic Management?

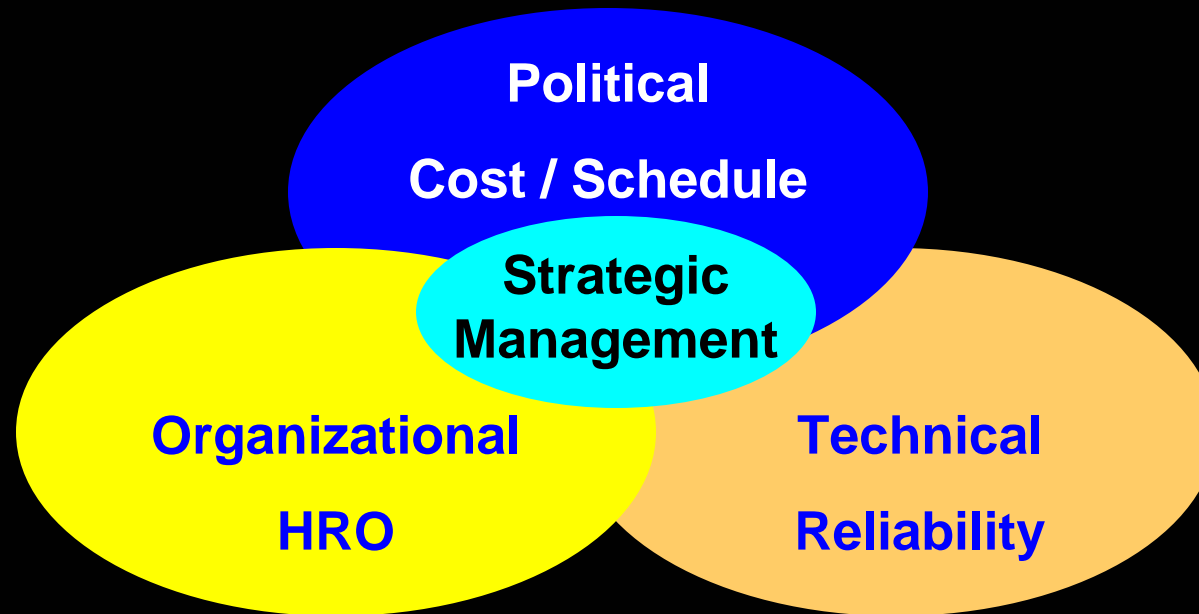
**The task of space management is rocket science. It is terribly complicated. Launchers explode and spacecraft disappear. No one wants to fail. Good enough is not good enough for mechanisms within which thousands of components must work in tandem for a mission to succeed.**

*“Bureaucracy and the Space Program,”*  
in Sadeh, ed., *Space Politics and Policy*, 2003.

# Strategic Management

- **Organizational structure for framing and executing (managing) programs and projects**
  - **Bureaucratic management**
    - **Organizational-Political nexus**
      - Management that mediates between organizational and political dimensions
  - **Technocratic management**
    - **Organizational-Technical nexus**
      - Management that mediates between organizational and technical dimensions

# Strategic Management Framework



# Variables

- **Political**
  - **Accountability**
- **Organizational**
  - **Cultures**
  - **Bureaucratic management**
    - **Decision-Making**
- **Technical**
  - **Technocratic management**
    - **Management methods**

# Political Context and Implications for Management

## **“Democratic Dilemma”**

**Political activity that is inescapable (formation of public policy) creates conditions that work to undermine the performance of HROs**

- **Incorporation of public accountability can influence the roles of technical competence and organizational controls that are critical for successful management**

**operational vs. experimental**

## Democratic Dilemma

- **Confirmation to political criteria**
  - **Cost, performance, and constituents**
- **Broad political consensus through coalition building**
  - **Increases complexity of external task environment**
- **Goal modification**
  - **Accommodation of political forces impacts technical design**
    - **Satisfy conflicting demands**

**Public policy processes work to exacerbate those very features (expense and complexity) of large-scale, complex programs and projects that make their development and implementation so difficult in the first place**

# Public Accountability

## **Public Choice vs. Bureaucratic Power**



# Cultural Context

- **Shared values, beliefs, and norms for behavior**
  - **Expectations on how the organization operates**
  - **Context for management behavior and task-related behavior**
- **Culture types**
  - **Competency**
    - **R&D culture, in-house capability, risk-taking**
    - **Project and team-based management methods**
  - **Control**
    - **Operations, contract-out, risk-avoidance**
    - **Systems management and configuration control methods**

# Changing Organizational Cultures

- **Decentralized-Centralized**
  - **Redundant communication paths**
- **R&D exploration ethos**
  - **Performance**
- **In-house capability**
  - **Systems integrator**
- **Risk-taking**
  - **Avoid an error of commission**
  - **Presume unsafe, prove safe**
- **Competence culture**
  - **Technocratic management**
- **Lead center**
  - **Blocked communication up hierarchy**
- **Operational utilization ethos**
  - **Efficiency vs. Reliability**
- **Contract-out**
  - **Role reversal**
- **Risk-aversion**
  - **Avoid an error of omission**
  - **Presume safe, prove unsafe**
- **Control culture**
  - **Bureaucratic management**

## Decision-Making (Apollo)

- **“Space-Age Management”**
  - **Integration of centralization and decentralization**
    - **“Triad” leadership**
    - **Balanced political, organizational, and technical variables**

“...success was possible because the basic pattern of organization provided for NASA gave it **flexibility**. Its administrative leaders used this asset to incorporate maneuverability into its organizational pattern. The necessary level of instability [**“desired disequilibrium”**] was accepted.”

Webb, *Space Age Management*, 1969

**Webb made sure technical choices were supported by organizational processes**

## Decision-Making (Post-Apollo)

- **Lead-center approach**
  - **Organizational controls weakened at the expense of technical competence**
  - **NASA became a confederation of quasi-independent field centers**
  
- **Created organizational and technical bounds**
  - **Groups within NASA advance their interests in ways that do not value-maximize the Agency as a whole**
    - **Bureaucratization**
  - **Normalization of deviance to management methods (SOPs)**
    - **Satisficing phenomena**
    - **Technical work group mindset**

## Technocratic Management

**Methods of technocratic management must not only mediate between the organization and the complex space technology, but must also be balanced with bureaucratic management, which frames organizational behavior and decision-making processes**

- **Project management**
- **Systems management**
- **Team-based management**

# Project Management

- **Technocrats manage the project**
  - Adherence to “engineering” profession
- **Useful for reliable, predicable operations**
  - Single point failures managed by engineering “culture” and redundancy
- **Problems**
  - Little hierarchical control from bureaucrats who can ensure organizational controls and accountability
    - Complex systems prone to failure
    - Budget and scheduling issues, and complexity
  - Complex technology with interactive failure modes

# Systems Management

- **Systems management adopted from the USAF**
  - **Overlays project management with a hierarchical bureaucratic control and oversight**
    - **Ensures organizational control through SOPs**
    - **Centralized integration and configuration control**
- **Problems**
  - **Hierarchical control at expense of technical competence**
  - **Normalization to SOPs**
    - **Risk-avoidance culture**
  - **Developed for experimental technology**
    - **Misapplication issues**

# Team-Based Management

- **Commonality**
  - Foster common goals
- **Co-location**
  - Core project team to promote teamwork
- **Protection**
  - Protect from bureaucratic interference
- **Empowerment**
  - Decisions for mission development and implementation
- **Involvement**
  - “hands-on” approach to maximize problem-solving capacity
- **Capacity**
  - Multitasking and technical competence
- **Ad-hoc Systems Management**
  - Peer review



## Conclusions

- **Variables of strategic management are causally linked**
  - **Management of one set of variables influences the other set**
- **Effective promotion of technical considerations and competence are of critical importance in implementation and management success**

Strategic management practices that strike a harmonious relationship among political, organizational, and technical variables provide centripetal forces to the centrifugal political and organizational pressures that work to mollify the technical management capabilities of high-reliability organizations